**Comments on**
**"Do Financial Variables help Forecasting Inflation and Real Activity in the Euro Area?"**

**by Mario Forni, Marc Hallin, Marco Lippi, Lucrezia Reichlin**

In my comments on this paper, I would like first to recast the paper in the context of former literature on assets prices before assessing the methodology proposed by the paper and finally raising a few issues.

## Usual models implemented to assess the predictive content of asset prices

The purpose of the study is to examine whether financial variables helps to forecast inflation and output in the euro area by comparing their predictive content by means of an out-of-sample exercise. To briefly set the scene, in the wake of the pioneering work of Harvey [1988] and Estrella and Hardouvelis [1991], the following equations are generally estimated to evaluate the predictive content of the yield curve for output growth:

$$\frac{400}{k}\log\left((\frac{y_{t+k}}{y_t}\right) = \alpha_0 + \alpha_1 s_t + \varepsilon_{t+k} \qquad (1)$$

where $y_t$ and $s_t$ measure real GDP and the term spread respectively. Equation (1) is called the quantitative model, which in fact gathers a marginal equation (the one step ahead forecast for k=1 measuring the impact of the yield spread on the quarter-on-quarter growth rate of real GDP growth) and a cumulated equation (the four steps ahead forecast for k=4 measuring the impact of the yield spread on the year-on-year growth rates of real GDP). In equation below (2) the term spread explains recessions, not output growth. This model is called qualitative and given by:

$$PR(RE = 1) = \Phi(\alpha_0 + \alpha_1 s_{t-k}) \qquad (2)$$

where $\Phi$ denotes the cumulative normal distribution, RE a variable whose value is 1 when there is a recession 0 otherwise and PR the probability that the variable RE is 1 or 0.

Generally, both equations may be enriched by the use of others regressors or may have more elaborated forms. To test whether or not the yield spread conveys useful information, an out of sample exercise is generally carried out. The root mean squares errors of equation (1) or the pseudo $R^2$ of equation (2) are compared with those of the same equation in which additional variables (leading indicators, stock prices…) have been included and those of a pure autoregressive model. In this respect the seminal paper from Estrella and Mishkin [1997] is illuminating. Although the paper focuses more on the qualitative model (2), it concludes that yield spreads convey useful information for forecasting recessions. Furthermore the model performs better than a model including traditional US leading indicators and stock prices. Overall, the main conclusions that can be drawn from the literature (mainly for US and some European countries) concerning the predictive power of financial variables are the following:

- variables with the clearest theoretical justifications for use as predictors have scant empirical contents. But inflation is found to have no power despite a clear theoretical content through the expectations hypothesis of the term structure of interest rates;

- there is evidence that the term spread is a serious candidate as a predictor of output growth and recession but the relationship is not stable over time, especially as regards equation (1). There is evidence of more stable results for the probit model;

- Stock and Watson (2000) have shown that single indicators of asset prices have a very limited predictive content. However, combined forecasts of these single models provide much more favourable results.

## The methodology implemented in the paper and the main results

The approach implemented in the paper differs from other related studies in two ways. First, the study focuses on the euro area as a whole although the set of information used is a pool of country data. Second, the authors based their analysis on a wider set of information (400 time series) as regards the financial predictor and competing variables. The computation of aggregated predictors is based on the generalised factor model. The construction of aggregated predictors relies on:

(i) the computation of dynamic common factors

(ii) pooling the leading variables into five blocks (industrial production, financial variables, money aggregates, price variables and miscellaneous variables) and within these blocks searching for leading variables and calculating the block leading factor using the Forni, Hallin, Lippi, and Reichlin (2000) method.

(iii) within each of these five groups a simple average of the leading variables is computed to define the predictor of interest. Therefore there are five aggregated predictors named $z_1, z_2, z_3, z_4, z_5$ representing respectively financial leading variables, monetary aggregates leading variables, industrial production leading variables, prices leading variables and surveys.

(iv) for forecasting industrial production and inflation, six models are estimated: a simple auto-regressive model (MO), and a series of models including either all predictors or all predictors but one of them on top of the auto-regressive term.

Finally, the out of sample exercise is performed by comparing out of sample forecasts from various models of the month-on-month growth rate of industrial production and the month on month growth rate of inflation at various horizons (from one month to twelve months). The out of sample methodology is, as usual, based on recursive estimations.

Overall, the results based on the root means square errors of the six models are the following:

- The proposed models beat the Stock and Watson model as well as the simple autoregressive model (except at 3 months in the latter case and for inflation);

- The use of financial variables does not help improve forecasts for industrial production at 1 and 3 months. This is also the case for inflation at 3 months. For inflation, excluding money at one month and surveys at 6 months is also helpful.

## Issues raised by the paper

### *General comment*

In the literature there are good theoretical underpinnings justifying why the yield spread may explain future output and inflation developments (c.f. Harvey [1988] and Hu [1993]): an intertemporal maximisation framework for real growth and the expectation hypothesis of the term structure of interest rates for inflation. Are there any strong theoretical reasons to use aggregated data beyond the pure empirical argument of a better forecasting capability? The authors should clarify this point ex ante.

This seems all the more important that the paper varies the set of blocks which are considered in order to deduct the best models and that the wider set of information is not necessarily the most efficient.

In fact, this variation of the blocks considered raises a fundamental issue concerning the reliability of the method proposed. How come that more information does not systematically improve the quality of forecasts? According to Forni, Hallin, Lippi, and Reichlin (2000), the quality of forecasts should increase when the number of series tends to infinity. However, with more than 400 time series considered, the observed improvement of forecasts obtained by the exclusion of some data shows that this is not the case yet. Hence two questions arise: is the method really useful if more than 400 series are needed to obtain convergence? Alternatively, could it be that the assumption of existence of common factors which underlies the method is too strong and can only be applied to some specific sets of data?

### *Constructing the common factor*

It is not obvious that the method allows for an interpretation of the common factors as it is the case in the usual static principal factor analysis in which the weight of each variable composing the axis can be determined. On a more technical note, is there any statistical criteria to select the number of factors instead of the pragmatic rule of thumb used?

### *The out of sample exercise*

Overall, it appears that this is not really an out of sample exercise.

- Indeed, the lags and the leads in the forecasting equations are computed by minimising the out of sample mean square errors. Hence, the out of sample forecast cannot be considered as based fully on within sample information.

- It would need to be shown, at least, that these mean square errors do not vary in size when the size of the out-of sample data increases.

- There is a deviation from a true real time forecast exercise because one uses the set of historical data rather than the set of provisional data although this feature is shared by most studies.

***Results***

- The fact that month-on-month growth rates are projected makes it difficult to assess their quality. Given the volatility of the series, it is not really surprising to find fairly bad results. In general, other papers assess the k steps ahead predictive contend with a cumulated equation (i.e. the year-on-year growth rate at a four quarters horizon). Results would certainly have been more encouraging by using this kind of approach. Moreover to find no predictive power at one month is not very surprising. Many papers have shown that it is very difficult to beat autoregressive models in the very short-run.

- The improvement compared with the static model is not obvious as no formal statistical tests to compare the forecast accuracy of the various models are carried out (Diebold-Mariano, West, for example).

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